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TESTS ON ELASTIC WHEELS FOR A SMALL LUNAR ROVER

Abstract

All robotic rovers for planetary exploration and the vehicles used to carry astronauts on the surface of the Moon used wheels as running gear. The same applies to the majority of projects for future exploration missions, both of the unmanned and manned types. Dynamic modeling of wheeled vehicles is a common practice in automotive technology, and commercial codes are usually employed. Such dynamic modeling however requires the knowledge of the wheel-terrain interaction that is usually beyond that available for the specific type of wheels designed for planetary rovers, in particular when they operate on regolith like in the actual working conditions. Several analytical wheel-terrain interaction models have been discussed in detail in the literature but, although many tests were performed in the past (starting from the 1970s for the Apollo LRV missions) there is a substantial lack of experimental data. Test campaigns aimed at characterizing the behavior of the specific non pneumatic, elastic but sometimes rigid, wheels designed for planetary rovers operating on specific soils that simulate the terrain (the so-called planetary simulant) which can be found in the actual applications are required. A test rig that can be used to characterize the wheel-ground interaction under different operating conditions was presented at the 64th IAC. The research continued in the last year, and after the test rig was shown to work as expected, a first test campaign was started on the elastic wheels designed for a small lunar rover. The tests were performed on a regolith simulant which, although not containing the finer fractions for safety reasons, allows characterizing properly the wheel performance. Several tests were performed, to measure the rolling resistance, the cornering force and the aligning torque as functions of the load, the sideslip angle and the camber angle. From the results obtained it was possible to approximate the wheel characteristics using the common empirical formulae usually employed to model the wheels in vehicle simulation.